Department of Mathematics

Barbhag College

1. Programme Outcome

B.Sc Regular with Mathematics & Mathematics as Generic Elective

Students who choose BMATH(H) Programme, develop the ability to think critically, logically and analytically and hence use mathematical reasoning in everyday life. Pursuing a degree in mathematics will introduce the students to a number of interesting and useful ideas in preparations for a number of mathematics careers in education, research, government sector, business sectorand industry. The program covers the full range of mathematics. The course lays a structured foundation of Calculus, Real and Complex analysis, Algebra, Differential equations and Mathematical modelling, Number theory, Graph theory, Mechanics and C-programming. An exceptionally broad range of topics covering Pure and Applied Mathematics:Linear Algebra, Metric spaces, Statistics, Linear Programming and Applications, Mathematical Finance, and Bio-Mathematics cater to varied interests and ambitions.Also, to carry out the hand on sessions in Computer lab using various CAS software to have a deep conceptual understanding of the above tools to widen the horizon of students' self-experience

2. Programme Specific Outcome:

a) B.Sc Honours in Mathematics

i) Communicate mathematics effectively by oral, written, computational and graphic means.
ii) Create mathematical ideas from basic axioms.
iii) Gauge the hypothesis, theories, techniques and proofs provisionally.
iv) Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and
Synthesis.
v) Identify applications of mathematics in other disciplines and in the real world, leading to enhancement
of career prospects in a plethora of fields.
vi) Appreciate the requirement of lifelong learning through continued education and research

3. Course Outcome

a) B.Sc Honours/Regular in Mathematics

Semester	Paper Code/Name	Course objective	Course outcome

B.Sc. 1st Semester	**MAT-HC-1016: Calculus (including practical)**	The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real world problems. Also, computer lab will help to have a deep conceptual understanding of the above tools in true sense	This course will enable the students to: i) Learn first and second derivative tests for relative extremum and apply the knowledge in problems in business, economics and life sciences. ii) Sketch curves in a plane using its mathematical properties in different coordinate systems. iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas. iv) Understand the calculus of vector functions and its use to develop the basic principles of planetary motion
	MAT-HC-1026:Algebra	The primary objective of this course is to introduce the basic tools of set theory, functions, induction principle, theory of equations, complex numbers, number theory, matrices and determinant to understand their connection with the real-world problems.	This course will enable the students to: i) Employ De Moivre's theorem in a number of applications to solve numerical problems. ii) Learn about equivalent classes and cardinality of a set. iii) Use modular arithmetic and basic properties of congruences. iv) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix. v) Learn about the solution sets of linear systems using matrix method and Cramer's rule

	MAT-HG-1016/MAT-RC-1016: Calculus	Calculus is referred as 'Mathematics of change' and is concerned with describing the precise way in which changes in one variable relate to the changes in another. Through this course, students can understand the quantitative change in the behaviour of the variables and apply them on the problems related to the environment.	The students who take this course will be able to: i) Understand continuity and differentiability in terms of limits. ii) Describe asymptotic behavior in terms of limits involving infinity. iii) Use derivatives to explore the behavior of a given function, locating and classifying its extrema, and graphing the function. iv) Understand the importance of mean value theorems.
B.Sc. 2nd Semester	**MAT-HC-2016 : Real Analysis**	The course will develop a deep and rigorous understanding of real line and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers. These concepts have wide range of applications in real life scenario.	This course will enable the students to: i) Understand many properties of the real line *R*, including completeness and Archimedean properties. ii) Learn to define sequences in terms of functions from *N* to a subset of *R*. iii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit Superior, limit inferior, and the limit of a bounded sequence.
	MAT-HC-2026:Differential Equations(including practical)	The main objective of this course is to introduce the students to the exciting world of differential equations, mathematical modeling and their applications.	The course will enable the students to: i) Learn basics of differential equations and mathematical modeling. ii) Formulate differential equations for various mathematical models. iii) Solve first order non-linear differential equations and linear

			differential equations of higher order using various techniques. iv) Apply these techniques to solve and analyze various mathematical models.
	MAT-HG-2016/MAT-RC-2016: Algebra	The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, number theory, matrices, determinant, along with algebraic structures like group, ring and vector space to understand their connection with the real-world problems	This course will enable the students to: i) Learn how to solve the cubic and biquadratic equations, also learn about symmetric functions of the roots for cubic and biquadratic ii) Employ De Moivre's theorem in a number of applications to solve numerical problems. iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix. Finding inverse of a matrix with the help of Cayley-Hamilton theorem iv) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, ring etc. v) Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space
B.Sc. 3rd Semester	**MAT-HC-3016 : Theory of Real Functions**	It is a basic course on the study of real valued functions that would develop an analytical ability to have a more matured perspective of the key concepts of calculus, namely; limits, continuity,	This course will enable the students to: i) Have a rigorous understanding of the concept of limit of a function. ii) Learn about continuity and uniform

		differentiability and their applications	continuity of functions defined on intervals. iii) Understand geometrical properties of continuous functions on closed and bounded intervals. iv) Learn extensively about the concept of differentiability using limits, leading to a better understanding for applications. v) Know about applications of mean value theorems and Taylor's theorem
	MAT-HC-3026 : Group Theory-I	The objective of the course is to introduce the fundamental theory of groups and their homomorphisms. Symmetric groups and group of symmetries are also studied in detail. Fermat's Little theorem is studied as a consequence of the Lagrange's theorem on finite groups	The course will enable the students to: i) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc. ii) Link the fundamental concepts of groups and symmetrical figures. iii) Analyze the subgroups of cyclic groups and classify subgroups of cyclic groups. iv) Explain the significance of the notion of cosets, normal subgroups and factor groups. v) Learn about Lagrange's theorem and Fermat's Little theorem. vi) Know about group homomorphisms and group isomorphisms.
	MAT-HG-3016/MAT-RC-3016: Differential Equations	The main objective of this course is to introduce the students to the exciting world of	The course will enable the students to: i) Learn basics of differential equations

		ordinary differential equations, mathematical modeling and their applications	and mathematical modelling. ii) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
B.Sc. 4th Semester	**MAT-HC-4016 :Multivariate Calculus**	To understand the extension of the studies of single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding. This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.	This course will enable the students to: i) Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion. ii) Understand the maximization and minimization of multivariable functions subject to the given constraints iii) Learn about inter-relationship amongst the line integral, double and triple integral formulations. iv) Familiarize with Green's, Stokes' and Gauss divergence theorems
	MAT-HC-4026 :Numerical Methods (including practical)	To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations and to find the approximate solutions of system of linear equations and 22 ordinary differential equations. Also, use of Computer Algebra System (CAS) by which the numerical problems can be solved both	The course will enable the students to: i) Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision. ii) Know about methods to solve system of linear equations, such as False position

		numerically and analytically, and to enhance the problem solving skills	method, Fixed point iteration method, Newton's method, Secant method and LU decomposition. iii) Interpolation techniques to compute the values for a tabulated function at points not in the table. iv) Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.
	MAT-HC-4036 : Ring Theory	The objective of this course is to introduce the fundamental theory of rings and their corresponding homomorphisms. Also introduces the basic concepts of ring of polynomials and irreducibility tests for polynomials over ring of integers.	On completion of this course, the student will be able to: i) Appreciate the significance of unique factorization in rings and integral domains. ii) Learn about the fundamental concept of rings, integral domains and fields. iii) Know about ring homomorphism and isomorphism theorems of rings. iv) Learn about the polynomial rings over commutative rings, integral domains, Euclidean domains, and UFD
	MAT-HG-4016/MAT-RC-4016: Real Analysis	The course will develop a deep and rigorous understanding of real line R and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers.	This course will enable the students to: i) Understand many properties of the real line R, including completeness and Archimedean properties. ii) Learn to define sequences in terms of functions from R to a subset of R.

			iii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence. iv) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
B.Sc. 5th Semester	**MAT-HC-5016 :Riemann Integration and Metric spaces**	To understand the integration of bounded functions on a closed and bounded interval and its extension to the cases where either the interval of integration is infinite, or the integrand has infinite limits at a finite number of points on the interval of integration. Up to this stage, students do study the concepts of analysis which evidently rely on the notion of distance. In this course, the objective is to develop the usual idea of distance into an abstract form on any set of objects, maintaining its inherent characteristics, and the resulting consequences.	The course will enable the students to: i) Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Fundamental theorems of integration. ii) Know about improper integrals including, beta and gamma functions. iii) Learn various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces. iv) Analyse how a theory advances from a particular frame to a general frame. v) Appreciate the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc. in an abstract setting. vi) Know about Banach

			fixed point theorem, whose far-reaching consequences have resulted into an independent branch of study in analysis, known as fixed point theory. vii) Learn about the two important topological properties, namely connectedness and compactness of metric spaces
	MAT-HC-5026 :Linear Algebra	The objective of this course is to introduce the fundamental theory of vector spaces, also emphasizes the application of techniques using the adjoint of a linear operator and their properties to least squares approximation and minimal solutions to systems of linear equations	The course will enable the students to: i) Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space. ii) Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix. iii) Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result. iv) Compute inner products and determine orthogonality on vector spaces, including Gram−Schmidt orthogonalization to obtain orthonormal basis.

			v) Find the adjoint, normal, unitary and orthogonal operators.
	MAT-HE-5016 : Number Theory	In number theory there are challenging open problems which are comprehensible at undergraduate level, this course is intended to build a micro aptitude of understanding aesthetic aspect of mathematical instructions and gear young minds to ponder upon such problems.	This course will enable the students to: i) Learn about some fascinating discoveries related to the properties of prime numbers, and some of the open problems in number theory, viz., Goldbach conjecture etc. ii) Know about number theoretic functions and modular arithmetic. iii) Solve linear, quadratic and system of linear congruence equations
	MAT-HE-5046 : Linear Programming	This course develops the ideas underlying the Simplex Method for Linear Programming Problem, as an important branch of Operations Research. The course covers Linear rogramming with applications to transportation, assignment and game problem. Such problems arise in manufacturing resource planning and financial sectors.	This course will enable the students to: i) Learn about the graphical solution of linear programming problem with two variables. ii) Learn about the relation between basic feasible solutions and extreme points. iii) Understand the theory of the simplex method used to solve linear programming problems. iv) Learn about two-phase and big-M methods to deal with problems involving artificial variables. v) Learn about the relationships between the primal and dual problems. vi) Solve transportation and assignment problems. vii) Apply linear programming method

			to solve two-person zero-sum game problems
	MAT-RE-5016: Number Theory	In number theory there are challenging open problems which are comprehensible at undergraduate level, this course is intended to build a micro aptitude of understanding aesthetic aspect of mathematical instructions and gear young minds to ponder upon such problems.	This course will enable the students to: i) Learn about some fascinating discoveries related to the properties of prime numbers, and some of the open problems in number theory, viz., Goldbach conjecture etc. ii) Know about number theoretic functions and modular arithmetic. iii) Solve linear, quadratic and system of linear congruence equations.
B.Sc. 6th Semester	**MAT-HC-6016 :Complex Analysis (including practical)**	This course aims to introduce the basic ideas of analysis for complex functions with visualization through relevant practicals. Emphasis has been given on Cauchy's theorems, series expansions and calculation of residues.	Completion of the course will enable the students to: i) Learn the significance of differentiability of complex functions leading to the understanding of Cauchy−Riemann equations. ii) Learn some elementary functions and can evaluate the contour integrals. iii) Understand the role of Cauchy−Goursat theorem and the Cauchy integral formula. iv) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

	MAT-HC-6026 :Partial Differential Equations (including practical)	The main objectives of this course are to teach students to form and solve partial differential equations and use them in solving some physical problems.	The course will enable the students to: i) Formulate, classify and transform first order PDEs into canonical form. ii) Learn about method of characteristics and separation of variables to solve first order PDE's. iii) Classify and solve second order linear PDEs. iv) Learn about Cauchy problem for second order PDE and homogeneous as well as nonhomogeneous wave equations. v) Apply the method of separation of variables for solving second order PDEs.
	MAT-HE-6046 : Hydromechanics	The main objectives of this course are to teach students about fluid pressure on plane surfaces, curved surfaces and Gas law. Also, introduces velocity of a fluid at a point, Eulerian and Lagrangian method, velocity potential and acceleration of a fluid at a point.	The course will enable the students to: i) Know about Pressure equation, rotating fluids. ii) Learn about Fluid pressure on plane surfaces, resultant pressure on curved surfaces, Gas law, mixture of gases iii) Learn about the Eulerian and Lagrangian method. iv) Learn about equation of continuity, examples, acceleration of a fluid at a point
	MAT-HE-6066 : Group Theory II	The course will develop an indepth understanding of one of the most important branch of the abstract algebra with	The course shall enable students to: i) Learn about automorphisms for constructing new

		applications to practical real-world problems. Classification of all finite abelian groups (up to isomorphism) can be done.	groups from the given group. ii) Learn about the fact that external direct product applies to data security and electric circuits. iii) Understand fundamental theorem of finite abelian groups. iv) Be familiar with group actions and conjugacy in S_n. v) Understand Sylow theorems and their applications in checking non-simplicity
	MAT-RE-6016 : Numerical Analysis	To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations, to find the approximate solutions of system of linear equations and Quadratic equations.	The course will enable the students to: i) Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision. ii) Know about iterative and non-iterative methods to solve system of linear equations iii) Know interpolation techniques to compute the values for a tabulated function at points not in the table. iv) Integrate a definite integral that cannot be done analytically v) Find numerical differentiation of functional values vi) Solve differential equations that cannot be solved by analytical methods